Printed Pages : 4 **TME-101**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4032 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. I) EXAMINATION, 2007-08

MECHANICAL ENGINEERING

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*
(2) Assume suitable value for missing data, if any.
(3) Use of steam table and Mollier's chart is allowed.

1 Answer any **four** parts of the following : **5×4**

(a) What do you mean by intensive and extensive properties ? Give examples. State your concept about thermodynamic equilibrium.

(b) What is quasi static process ? What are the causes of irreversibility in a process ?

(c) What do you understand by the term "entropy" ? Explain the principle of entropy increase.

(d) Explain your concept about the perpetual motion m/c of 1st and 2nd kind ?

(e) What do you mean by COP ? Show that $(COP)_{Heat\ Pump} = (COP)_{Refrigerator} + 1$ where both Heat Pump and Refrigerator work between the same higher and lower temperature limits.

(f) A cyclic heat engine operates between a source temperature of 700°C and a sink temperature of 30°C what is the least rate of heat rejection per kW net output of the engine ?

2 Answer any **four** questions : **5×4**

(a) Write the difference between SI and CI engine ?

(b) Draw T-S diagram for Rankine cycle. Briefly explain the effect of superheat in Rankine cycle efficiency.

(c) What is pure substance ? What is the use of steam table and Mollier diagram ?

(d) Show that for the same compression ratio and heat rejection Otto cycle will give higher efficiency than diesel cycle.

(e) Derive a relation for the air-standard efficiency of Otto cycle. Also show the cycle on P-V and T-S diagrams.

(f) A Diesel cycle takes air at 1 bar and 300 K and compresses it to 16 bar. Heat is added till its temperature becomes 1700 K. Calculate the (i) work from the cycle (ii) air standard efficiency.

3 Answer part (a) and any **two** more from the remaining :

(a) Explain the following : **2×3**
(i) Principle of transmissibility of forces
(ii) Parallelogram law of forces (iii) Law of friction.

(b) Two rollers of mass 20 kg and 10 kg rest on a horizontal beam as shown in **fig. 1** with a massless wire fixing the two centers. Determine the distance x of the load 20 kg, from the support A, if the reaction R_A is twice of the support reaction R_B. The length of the beam is 2 m and the length of the connecting wire is 0.5 m. Neglect weight of beam. Assume the rollers to be point masses neglecting its dimensions. **7**

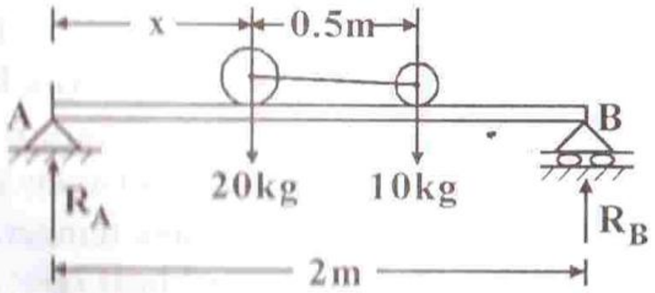

Fig. 1

(c) Obtain the resultant of 5 forces; 10 kN, 15 kN, 20 kN, 40 kN and 80 kN which are acting at one of the angular points of a regular hexagon towards five other angular points respectively. **7**

(d) A flat belt running at a speed of 500 m/min drives a pulley. Determine the power transmitted by the belt, if the maximum tension on the tight side of the belt is 1200 N. Neglect the centrifugal tension effect. The angle of lap is 160° and the coefficient of friction between the belt and pulley material is 0.35. **7**

4 Answer any **two** parts of the following : **10×2=20**

(a) Determine the forces in each member of the loaded cantilever truss by the method of joints. (**fig-2**).

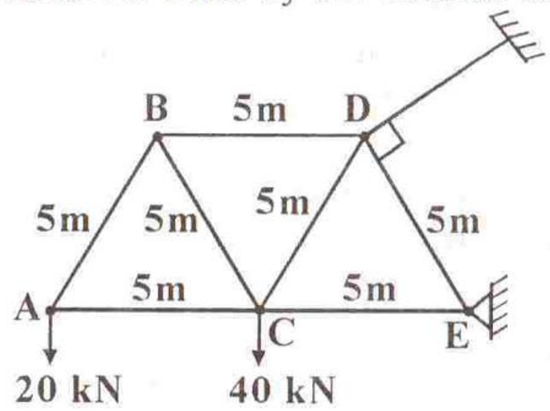

Fig. 2

(b) For the overhanging beam as shown in **fig-3**, draw the shear force and bending moment diagrams. Find out the position and magnitude of maximum bending moment. Also determine the location of any point of contraflexure.

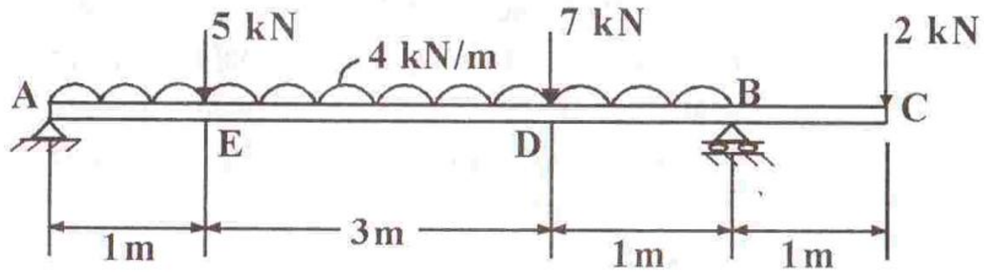

Fig. 3

(c) (i) What are the assumptions taken for the analysis of trusses ? Explain the logic of each assumption.

(ii) Why shear force and bending moment appear in a loaded beam ? Develop an expression between loading, shear force and bending moment.

5 Answer any **two** parts of the following : **10×2=20**

(a) What are Principal Planes and Principal Stresses ? For a general bi-axial stress system, prove that the maximum shear stress is half of the algebraic difference of principal stresses.

(b) Explain/discuss the followings : **2.5+2.5+2.5+2.5**

(i) Mohr's circle

(ii) Modulus of elasticity E, rigidity modulus G and bulk modulus K.

(iii) Expression for resilience of a bar in terms of applied stress and Young's modulus.

(iv) Principle of superposition for elongation of bars of varying cross-section.

(c) (i) A CI pipe of wall thickness 10 mm and outside diameter 120 mm carries water and is supported at a distance of 9 m. Calculate the value of maximum bending stress and its nature when water is running full. Take density of water as 1 g/cc and that for CI as 7 g/cc. **5+5**

(ii) A solid shaft of 200 mm diameter has the same cross-sectional area as that of a hollow shaft of the same material with inside diameter of 150 mm. Determine the ratio of the power transmitted by the two shafts at the same speed.